Underground Laser Scanning:

Producing Useful Deliverables

By Seaver Hall, Project Engineer

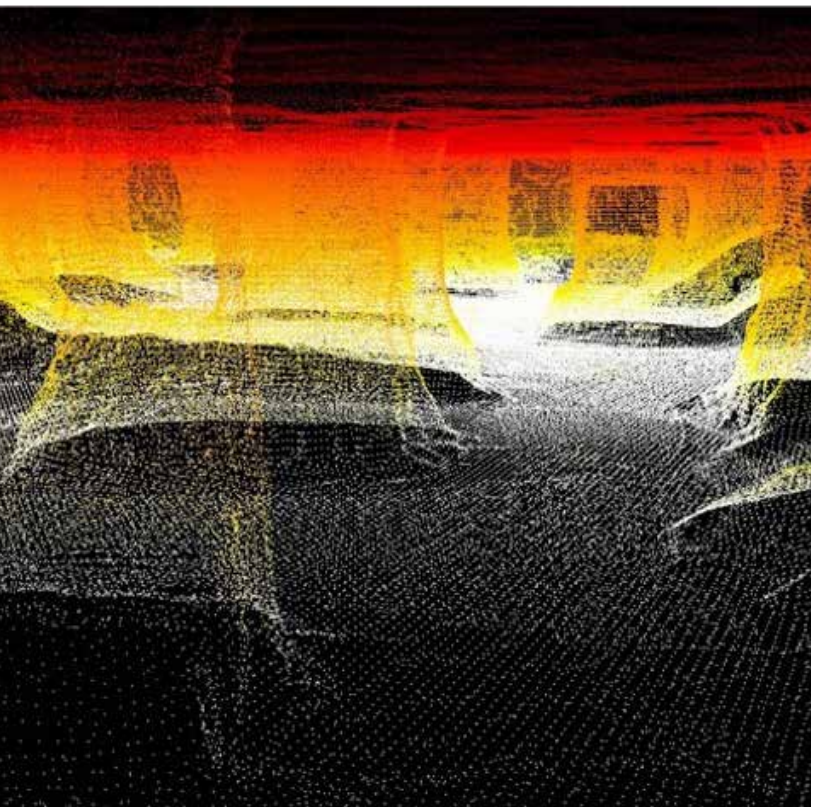
Access to geospatial data has never been easier. Data Analysts and Data Scientists are among the most desired and highest trending jobs in the world. However, more data is not always better. While working at Firmatek, where we specialize in processing 3D point clouds, the most frequent response from clients is, “the file is too big, I can’t open it.” A processed 3D point cloud is one of the coolest things to look at, but the data brings an enormous depth of value besides just looking cool. For example, the raw point cloud of a 20-foot long underground slope conveyor belt can be 10+ gigabytes (GB) worth of data, but for most people that high resolution cluster of data is unusable. The true challenge working with clients to solve problems is making the final deliverable something that is manageable and valuable to the end user. Underground mapping with LiDAR has been around for years, and we are now figuring out how to make this data more useful by creating deliverables like CAD files, change detection models, and 3D PDFs that can be viewed without high end and expensive software and hardware. In this paper, we will explore Firmatek’s underground data collection process as well as the types of analysis and deliverables that have proved valuable for Firmatek’s underground mining clients.

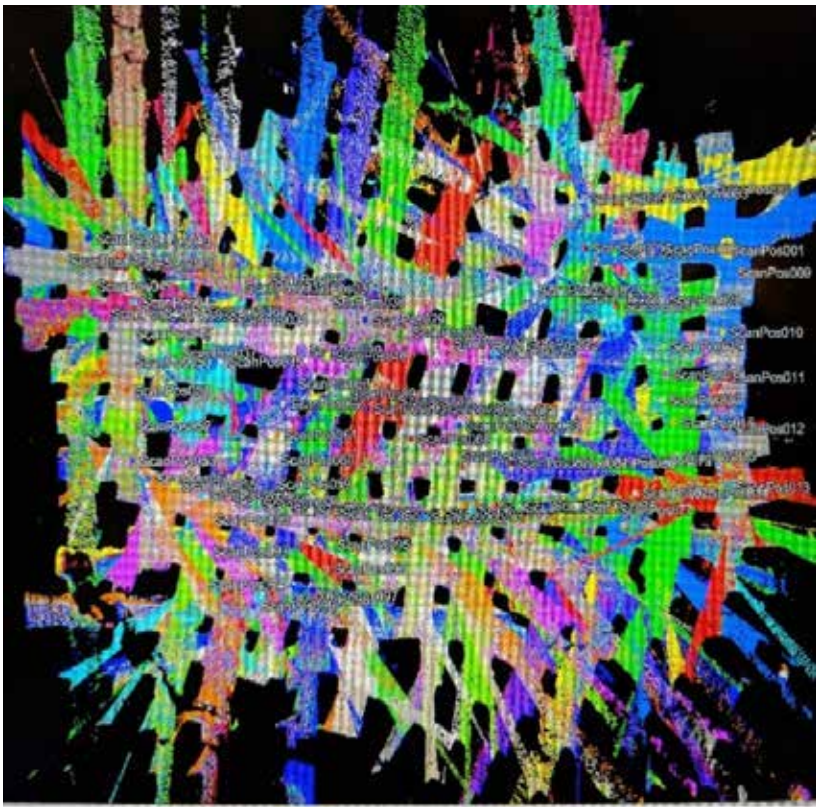
Data Collection

There are many capable LiDAR scanners that can be used for underground mapping. Firmatek uses the Riegl VZ-400 scanner, which is one of our standard pieces of equipment that we use in our above ground mapping projects. The Riegl VZ-400 is a stationary scanner that scans 360° horizontally and 100° vertically. Firmatek's goal is to scan about 75% overlap on each scan to guarantee good registration of all the scans. This unit typically uses GPS to lock in a scan geospatially, but there is no GPS underground. To ensure geospatially correct data, it is a best practice to shoot in targets with traditional surveying methods and localize the point cloud to these targets. This process is also known as placing benchmarks. Field time for the majority of Firmatek's underground projects is typically less than a day.

Data Processing and Deliverables

After the initial data collection is completed, all of the individual scans are registered together to create one seamless, continuous point cloud. Once the point cloud is processed to eliminate dust, equipment, and any noise, there is useful data that can be viewed via computer. Without survey control or benchmarks, this newly created point cloud can be used to get accurate dimensions, calculate volumes or perform physical measurements, but it is not yet positioned correctly on the mine grid. While these calculations or measurements could be somewhat useful, the most meaningful analysis comes when these point clouds have been positioned correctly on the mine grid.

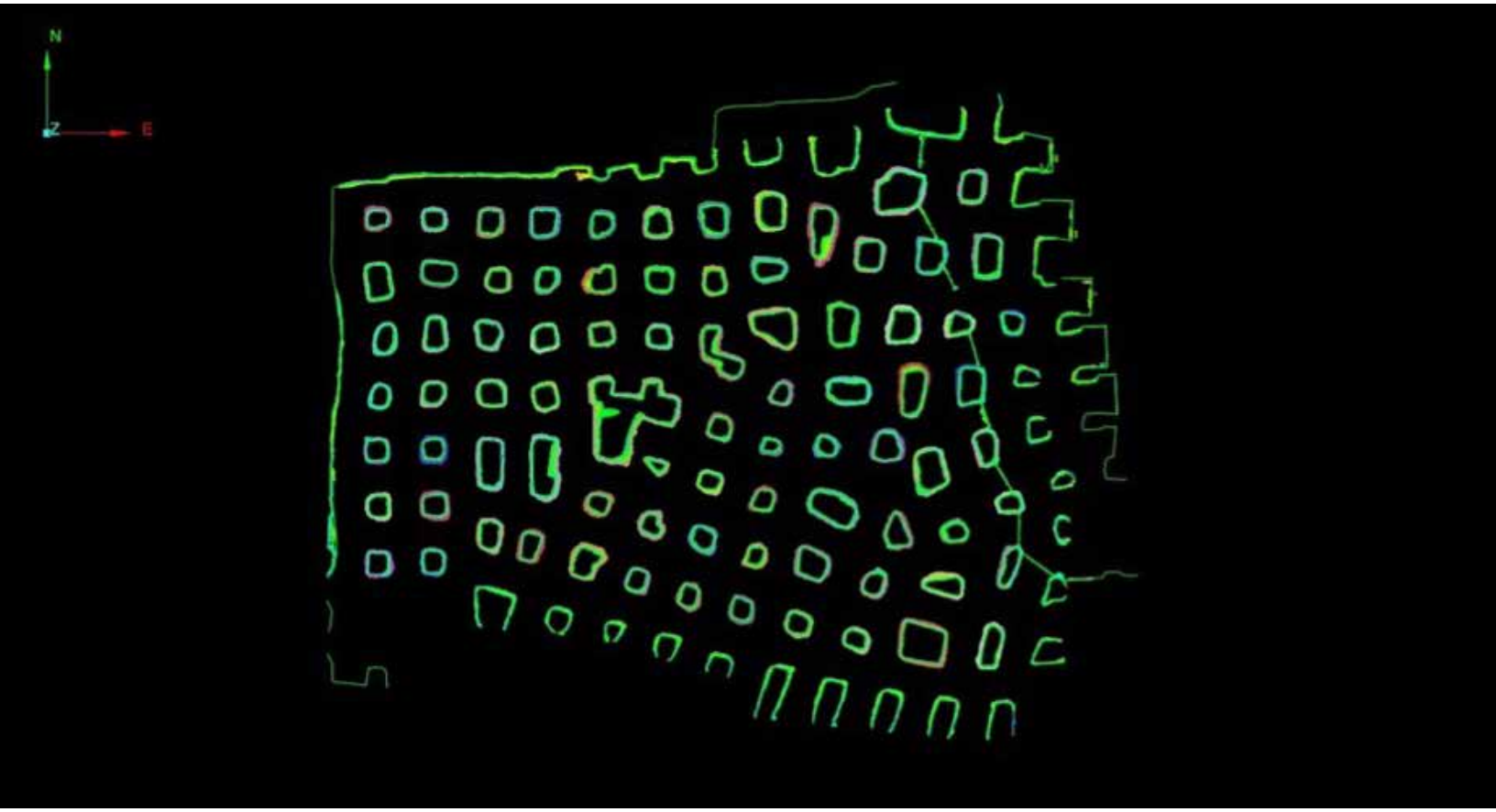




Above: Filtered down point cloud of room and pillar mine.

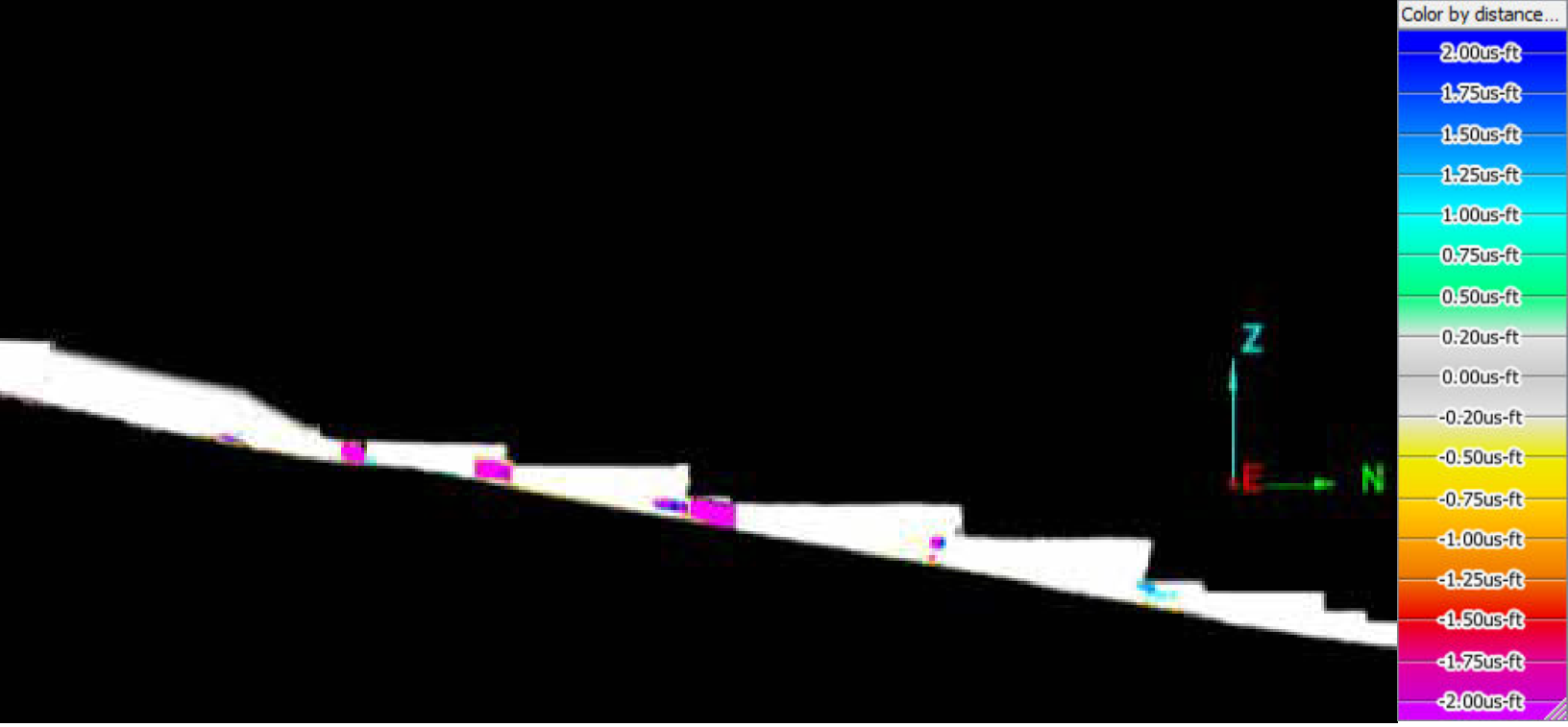
It is worth noting that these point clouds can be upwards of 10GB and are very difficult to work with unless you have access to a powerful computer. However, from these large point clouds Firmatek can create CAD files for utility lines, precise measurements of columns, produce general dimensions of rooms or slopes, and more.

For one ongoing project, the owner is building a storage facility within the space of a non-operating room and pillar mine. Firmatek delivered CAD boundaries of each pillar and topographic CAD data of the roof and floor that was used for the planning and construction of the underground storage space. These CAD files allowed for the proposed structures to be designed around the existing pillar layout and for the components to be prefabricated, reducing the scheduled time for construction and avoiding costly field fabrication.



Above: CAD boundaries of columns and walls.

Another example of a deliverable that Firmatek provides is 3D solid models from the laser scan data that is collected. If given historical data, we can detect any change or movement from scan to scan. This detection capability can help structural engineers assess structural integrity and help predict future failures. Additionally, 3D PDF's can be created from these models and can be interactively viewed on an average, everyday laptop. The 3D solids are also used in mine planning to calculate the volume of material removed and the amount of material still in reserve.



Above: 3D model colored by distance from a previous scan, showing any change.

Conclusion

Producing customized deliverables that are tailored to a particular project or client can give owners valuable information to help them analyze current situations, solve problems and avoid costly mistakes in the future. Not every user has access to powerful computers and the latest software, so sometimes smaller files will benefit them as much or more than high resolution point cloud with 50 million points. Laser scanning technology is not new, but new software tools are making it possible to present and deliver this complex data in more useful ways.

While we've learned that data collection is becoming increasingly widespread and easily accessible, we know that real solutions come from understanding and analyzing the data that is collected. Transforming data into actionable insights to help our clients comprehensively understand their operations is what the Firmatek team delivers. Data is more than a number. Firmatek has worked with clients over the years to develop meaningful and accessible deliverables for underground mining applications that clients are using to save money and improve operations.

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